increase in number of erythrocytes in these animals. If polycythaemia is due to some direct nervous influence it might be expected that in these animals in which the nervous condition is intact, nervous stimuli as fright, would cause an increase in number of red corpuscles.

As the direct stimulation of the nerves to the liver causes no increase in number of erythrocytes, and as in animals in which epinephrin causes no polycythaemia nervous stimuli also cause no increase in number of red corpuscles, it appears probable that the polycythaemia following the stimulation of certain nerves is not due to a direct nervous influence, but to a reflex stimulation of the adrenals and a secondary action of epinephrin on the liver.

[1] Lamson, P. D., These PROCEEDINGS, **1**, 521-525 (1915).

[2] Lamson, P. D., *J. Pharm. Exp. Therap.*, **7**, 169-224 (1915).

[3] The terms red count, number of red corpuscles, etc., will be used occasionally for the sake of brevity, instead of the more exact term, number of erythrocytes per unit volume of blood.

[4] Lamson, P. D., and Keith, N. M., *J. Pharm. Exp. Therap.*, **8**, 247-251 (1916).

[5] Lamson, P. D., *J. Pharm. Exp. Therap.*, **8**, 167-173 (1916).

[6] Mautner, H., and Pick, E. P., *Münchener med. Wochenschr.*, Nr. 34, S. 1141, 1915.

THE INFLUENCE OF MORPHIN UPON THE ELIMINATION OF INTRAVENOUSLY INJECTED DEXTROSE IN DOGS

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The sugar content of the circulating blood is practically constant. This constancy is upheld by some stable mechanism which controls the supply of sugar to and its elimination from the circulation. Some time ago[1] we communicated the instructive fact that after the intravenous injection of four grams of sugar per kilo of body weight the sugar content of the blood returns to nearly normal again in about 90 minutes. These animals had ether anesthesia during the operation and afterwards a subcutaneous injection of morphin. The question presented itself, whether the anesthetics which were used influenced the rate of elimination of the added sugar through the kidneys and the blood capillaries, or, to express it in the terms of the hypothesis which was uppermost in our minds, whether the anesthetics affected the *physiological permeability* of the endothelia and epithelia which are concerned in the process of elimination.

We tested first the action of morphin alone. Two series of experi-

ments were made. Eight dogs received morphin, about ten milligrams per kilo body weight. Ten dogs were operated under local anesthesia produced by cocain or ethylchloride; no anesthesia was needed during the infusion of the sugar solution. In all cases of both series four grams of dextrose per kilo body weight was given, the duration of the intravenous infusion being in all cases about one hour. The dextrose was given in a 20% solution, the solvent being water, except in four non-morphinized dogs in which the dextrose was dissolved in an M/4 solution of sodium sulphate—for reasons which will be stated later.

The resulting differences were striking and instructive. We shall give first the urinary results. In the morphinized dogs the elimination of the sugar through the urine was considerable. In eight experiments the average quantity of sugar in the urine secreted in two hours and a half (that is from the beginning of the injection to one hour and a half after the end of it) amounted to 63% of the injected sugar, 80% being the largest and 52% the lowest quantity. The average quantity of sugar in the urine of six non-morphinized dogs (those which received the dextrose in water), in two hours and a half, amounted only to about 17% of the injected sugar, about 30% being the highest and about 4% the lowest quantity.

There was, however, a proportionate difference between the two series of dogs also in the volume of the secreted urine. In the morphinized dogs the average of the injected dextrose solution was 137 cc. and of the secreted urine—197 cc.; that is, the quantity of the secreted urine exceeded that of the injected sugar solution, while in the non-morphinized dogs the average of the injected dextrose solution was 187 cc. and of the secreted urine only 83 cc.; that is, the quantity of the secreted urine was much smaller than that of the injected sugar solution. It could then perhaps be assumed that the morphinized dogs eliminated more sugar merely because they have secreted more urine. On this account experiments were made on four non-morphinized dogs in which the dextrose was dissolved in 1/4M solution of sodium sulphate. That produced a greater diuresis; here the relation of the volume of the secreted urine to the volume of the injected dextrose was reversed: 212 cc. of dextrose solution injected and 281 cc. of urine secreted. Nevertheless, the relation of the elimination of sugar in the urine was not reversed. In fact, in those four experiments with non-morphinized dogs the elimination in the urine of sugar was even diminished; it amounted on the average only to 9.2% of the injected sugar, about 13% being the highest and 7% the lowest quantity.

These three series of experiments show, then, that morphin increases

considerably the elimination through the kidney of intravenously injected sugar, and increases moderately the volume of the secreted urine.

In these various series of experiments also the sugar content of the blood was tested and compared with one another. Tests were made before the intravenous injection of sugar and at the end of it, and thirty minutes, sixty minutes and ninety minutes after the end of the injection. The results were in a certain sense opposite to those observed for the urine. The averages for six morphinized dogs were as follows: 0.24% before the injection, 0.99% at the end, 0.57% after thirty, 0.41% after sixty and 0.32% ninety minutes after the end of the injection. The average for six non-morphinized dogs (dextrose in water) were: 0.16% before the injection, 0.6% at the end, 0.19% after thirty, 0.16% after sixty and 0.16% ninety minutes after the end of the injection. These data mean that in morphinized dogs, after intravenous injection of dextrose, the sugar content of the blood returns to the normal level much slower than in non-morphinized dogs.

However, in consideration of the fact that morphin alone causes a moderate hyperglycaemia (with a very slight glycosuria) two experiments were made on non-morphinized dogs which had at the start a hyperglycaemia. These animals received intravenously one gram of dextrose per kilo, which brought the glycaemia to 0.35%; then four grams more per kilo were injected. At the end of this injection the hyperglycaemia was 0.45%; thirty minutes after the end, about 0.16%; after sixty minutes, 0.15%; and after ninety minutes, 0.15%. This shows that without morphin the sugar of the blood returns more rapidly to the normal level even when the intravenous injection of four grams of sugar per kilo is started while the sugar content of the blood is temporarily on a level higher than that due to morphin. The elimination of sugar in the urine amounted to about 18.5% of the entire quantity of the injected sugar.

Our experiments show the following facts. 1. Morphin, in the dose employed in our experiments, increases considerably the elimination through the kidneys of intravenously injected dextrose, although the increase in the volume of secreted urine is comparatively moderate. Without morphin the elimination of sugar is comparatively small even if the volume of the secreted urine is considerably increased by the addition of sodium sulphate to the intravenously injected dextrose. 2. Morphin retards the return of the sugar content of the blood to its previous level. The originally slightly higher level of glycaemia which is produced by morphin itself does not seem to be responsible for either the slow return of the glycaemia or for the greater elimination through the kidney.

If we assume with Heidenhain and others, as most physiologists now do, that urine is produced by a 'vital' activity of the cells of the glomeruli and of the convoluted tubules, we may perhaps express our findings by the statement that morphin increases the 'physiological permeability' of the kidney cells while it decreases the same kind of permeability of the endothelia of the capillaries of other tissues of the body.

[1] Kleiner and Meltzer, *Amer. J. Physiol.*, **33**, 17 (1914); also Kleiner, *J. Exp. Medicine*, **23**, 507 (1916).

THE WORK OF THE AMERICAN METEOR SOCIETY IN 1914 AND 1915

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The year 1915 saw a very great increase in the interest in the study of meteors, which was evidenced by the large number of observations made by members of the American Meteor Society. This gratifying increase became largely possible on account of a grant to Dr. S. A. Mitchell of the Leander McCormick Observatory from the J. Lawrence Smith fund of the National Academy of Sciences. This appropriation, which was made in April, 1915, permitted the work of the Meteor Society to obtain wider publicity by the publicaion and distribution of bulletins, maps and blanks to prospective members.

As a consequence, it is believed that the largest amount of systematic work ever done in one year in America, was sent in; the results of these observations have been prepared for publication and are now awaiting printing. Briefly, this publication will contain the results from 540 observations made by 4 persons in 1914 and from 5003 observations made by 36 persons in 1915. While most of these 36 persons are amateurs, five have had astronomical training, one is a colonel in the U. S. Army, one is an observer of meteors in the U. S. Weather Bureau of wide experience, three are students in astronomy at the University of Virginia, and several others are trained in various scientific lines which would make their work the more valuable. The observers were stationed in 17 states, 2 provinces of Canada, and one in the Argentine Republic. It might be added that the Meteor Society has members in several foreign countries and several dozen more in America from whom no reports have yet been received, while a week rarely passes without a new person applying for membership.

From the 5543 observations of meteors mentioned, we have been able